DEPARTMENT OF ECOLOGY
State of Washington

Design Deliverables for Stormwater Projects with Ecology Funding

This document details Ecology's expectations of deliverables for Ecology funded stormwater projects.

Table of Contents

Section A – Design Report

This section intends to help grant and/or loan recipients identify the necessary information to include in Design Reports. Ecology does not require that reports follow this outline, but including the information listed expedites the review process. The information required varies by project. Some projects may require additional information, and others may not need as much.

The intent of the Design Report is to demonstrate that the project:

- Has not changed from the project in the original application
- Uses the applicable design guidance for the proposed BMP(s)
- Provides a quantifiable Flow Control and/or Runoff Treatment benefit

Design Reports for Ecology review should include the following:

1. Introduction

Provide a brief description of the project, including elements such as project location and goals. Include figures as appropriate to show the location and layout of the project.

2. Basin Description

Describe the basin that the project lies within under historic, existing, and proposed conditions. Provide figures that show topography and flow direction. Provide information such as current and future land use (i.e. residential, commercial, industrial), soils, area, water bodies, etc.

3. Site Description

Provide detailed information about the project site including but not limited to:

- Project Limits
- Threshold Discharge Areas (TDAs)
- Current use
- Proposed use
- Existing stormwater features
- Proposed stormwater features
- Total area
- Vegetation
- Wetlands
- Soils
- Access
- Other information relevant to the project design, construction, or maintenance

4. Minimum Requirement (Western Washington)/Core Element (Eastern Washington) Analysis

Ecology expects the following analysis for all projects, even if the proposed project is a retrofit. Ecology will use the Minimum Requirement/Core Element Analysis to verify:

- project eligibility, per the applicable funding guidelines
- project compliance with the NPDES Municipal Stormwater Permit, if the project is within a permitted jurisdiction

These are the main steps in this analysis:

a. Identify and tally the pollution generating and non-pollution generating surfaces pertinent to the MRs/CEs thresholds. Keep each area separate. Examples of areas you may need to identify are:

    - new hard surfaces
    - replaced hard surfaces
    - existing hard surfaces
    - effective impervious surfaces
    - effective hard surfaces
    - lawn/landscaped areas
    - pasture areas
    - total land disturbed

b. Include an analysis to determine the MRs/CEs applicable to the project (Figures 2.4.1 and 2.4.2 in Ecology's 2014 Stormwater Management Manual for Western Washington, Section 2.1 in Ecology's 2004 Stormwater Management Manual for Eastern Washington). State which MRs/CEs apply, and to which surfaces within the project limits.

    - For projects in Western Washington that require MRs #6 and #7 after the project level analysis, you must also provide a threshold analysis for MRs #6 and #7 for each Threshold Discharge Area (TDA) within the project site.

If the analysis above shows that the project does not exceed new/redevelopment thresholds, the project is a retrofit project.

If the project exceeds the new/redevelopment thresholds and must comply with MRs/CEs for Runoff Treatment and/or Flow Control, provide an analysis of the proposed BMP(s) that provide Runoff Treatment and/or Flow Control for the new and/or replaced surfaces. Identify those BMPs that provide Runoff Treatment and/or Flow Control for existing surfaces above and beyond those required by the MRs/CEs. Ecology considers the BMPs outside of those used to satisfy the MRs/CEs to be retrofit.

Ecology makes an exception for permeable pavement when determining what portions of a project are retrofit, when the funding is only for retrofit elements. If the project is for the replacement of existing conventional impervious pavement with permeable pavement, then Ecology may consider the permeable pavement to be eligible even if it exceeds the new and redevelopment thresholds. Ecology will make this consideration when the permeable pavement is the only trigger for the Minimum Requirements.

5. Alternatives Considered

Briefly discuss alternatives considered and why you did or did not select them.

6. Design Analysis

a. Describe the chosen alternative in detail. Name the specific BMP whose design criteria you are using, e.g. BMP T5.15: Permeable Pavements or BMP T7.30: Bioretention Cells, Swales, and Planter Boxes.
b. Provide drawings of the proposed site improvements.
c. Provide a schematic of flow through the facilities if needed to assist in describing the proposed work.
d. Provide hydraulic profiles, if appropriate.
e. Describe and/or show the basin contributing to each proposed BMP. Consider and include offsite areas that contribute runoff to the BMP.
f. If the project proposes a BMP with an infiltration component, including Bioretention and Permeable Pavement, describe the results from the site specific characterization, soil and infiltration testing. Typically, this will include the long term hydraulic conductivity rate from the geotechnical report and the suitability of soil for treatment.
g. Provide detailed design calculations.
    I. Provide sizing calculations for the selected Runoff Treatment BMP(s). Identify the water quality design flow or volume you use for sizing each Runoff Treatment BMP. This flow or volume may be less than that required for a new/redevelopment BMP if there are site conditions that limit the size of the BMP, and the project does not trip the new/redevelopment thresholds.
    II. Provide sizing calculations for the selected Flow Control BMP(s). Include an analysis of the flows out of the BMP (use WWHM in western WA and local approved method in eastern WA).
    III. Summarize the calculation inputs and results for the Runoff Treatment and/or Flow Control improvements.
h. Summarize the model results and refer to the computer model printouts, if used. This may involve using “print screens” to include all the relevant information.

7. Quantify the Water Quality Benefit

Discuss the amount of water quality benefit expected based on the current level of design.

Provide a discussion that compares the amount of Runoff Treatment and/or Flow Control provided in the proposed project to the amount of Runoff Treatment and/or Flow Control required under full new/redevelopment standards for the area contributing to the BMP. Provide the calculations necessary to verify the discussion. See Section D below for Ecology’s guidance on how to quantify the water quality benefit.

8. Engineer’s Opinion of Probable Cost

Provide a breakdown showing the total project cost. Additionally, identify what items you consider eligible for Ecology funding. Ecology typically funds the footprint of eligible BMP(s) and immediate connections to existing facilities/discharge points. Ecology will review the proposed cost breakdown to confirm funding eligibility.

9. Proposed Schedule

Provide the proposed project schedule. This includes all design and construction milestones. Include Ecology deliverable review times and the grant agreement deadline in the schedule.

10. Attachments

Attachments commonly included in design reports include, but are not limited to:

- Basin Maps
- Project Limits/TDA Maps
- Preliminary Plans
- Cost Estimate Details
- Storm Simulation outputs and screenshots (e.g. WWHM2012 output)
- Geotechnical Reports, including:
    - Infiltration test results
    - Soil Suitability Lab test results
    - Physical soils test results

Section B – 90% Design Package

Ecology expects the 90% Design Package to detail the completed final design. Ecology has labeled the package as 90% instead of 100% to allow you to incorporate any comments received from Ecology or any other reviewing parties between the 90% design and the Final Bid Package. Reduce all figures and drawings to 11x17 inches in size.

You need to include the information from the following two Ecology inserts in your plans and specifications:

- Stormwater Grant Program Bid Specification Clause
- Stormwater Grant Program Bid Insert

You can obtain digital copies of the two inserts at the bottom of:
http://www.ecy.wa.gov/programs/wq/funding/GrantLoanMgmtDocs/Eng/GrantLoanMgmtEngRes.html

It will expedite the review process if you provide a memo that lists each required insert item and where you have inserted the information within the plans and/or specifications, i.e. page numbers and/or sheet numbers.

The 90% Design Package includes:

- 90% Plans
- 90% Specifications
- 90% Engineer's Opinion of Probable Cost
- 90% Project Schedule
- Revised Calculation of Water Quality Benefit (Section D), if the project changed during final design.

Section C – Final Bid Package

Ecology expects the Final Bid Package to detail the completed final design, with any comments from the 90% Design Package incorporated. Ecology expects digital copies only of this submittal.

The Final Bid Package includes all documents used for bidding, including but not limited to:

- Final Plans
- Final Specifications
- Addenda
- Final Engineer's Opinion of Probable Cost
- Anticipated Project Schedule

Section D – Quantifying the Water Quality Benefit

Retrofit projects are not required to meet the new and redevelopment criteria established in the three Municipal Stormwater General Permits. As a result, Ecology has not previously established a standardized method to demonstrate how much Runoff Treatment or Flow Control has been accomplished though retrofit projects funded through Ecology. The system discussed below is an attempt to quantify the level of improvement realized through retrofit projects.

Ecology has established Runoff Treatment and Flow Control design criteria for projects that exceed new and redevelopment thresholds as defined in Chapter 2 of Volume I of the Stormwater Management Manual for Western Washington (SWMMWW) and Chapter 2 of the Stormwater Management Manual for Eastern Washington (SWMMEW). The design criteria are well defined and it is clear how to calculate the size of Runoff Treatment and Flow Control BMPs for any given new/redevelopment project. By calculating the size of BMPs that you must install if you needed to meet new/redevelopment standards, a designer can calculate a baseline for comparison purposes.

For retrofit projects that are not required to meet the new/redevelopment standards, the size and environmental constraints within the project site could control the size and capacity of the proposed Runoff Treatment or Flow Control BMP. By comparing the size of the proposed retrofit BMP to the size of a BMP designed to meet new/redevelopment criteria, the designer can demonstrate the level of water quality benefit obtained. Ecology requires that the recipients of Ecology funds calculate two ratios to demonstrate the retrofit water quality benefit:

1. Flow Control Ratio
2. Runoff Treatment Ratio

Once these ratios are calculated, the applicant can develop an *Equivalent New/Redevelopment Area* for the retrofit project. Projects in Flow Control Exempt basins do not have to calculate the Flow Control Ratio. Projects that provide both Runoff Treatment and Flow Control would provide two separate equivalency values, one for Flow Control, and one for Runoff Treatment.

This information, while not difficult to obtain, does require more detailed information than is typically available at the funding application stage. The designer should include this information with the Design Report submitted to Ecology as part of the funding requirements. Ecology will require that the designer revise the comparison, as necessary, with submittal of the 90% Design Package and again following construction of the BMP. Ecology will use this information to quantify the water quality benefits realized by retrofit projects funded by Ecology.

The designer may do the comparison using the following methods:

1. Western Washington

The procedures below outline methods to estimate the areas improved by proposed Flow Control and Runoff Treatment retrofit projects.

1.1 Procedure for Comparison – Flow Control BMPs

Procedure WFC-1: Analysis for Size of Detention/Retention Flow Control BMP

- Run the pre-developed condition for WWHM using the basin area contributing to the BMP.
    - Use forested land cover, except where historic information indicates the area was prairie prior to settlement (then use the pasture land cover)
- Size the Flow Control BMP to meet new/redevelopment criteria for the proposed land use of the basin contributing to the BMP immediately after the construction of the project. Using the Auto Pond function is an acceptable method to obtain this information for detention/retention BMPs.
- Calculate the volume of the proposed retrofit Flow Control BMP at the overflow elevation.
- Calculate the ratio of the proposed retrofit Flow Control BMP volume to the volume of the Flow Control BMP required to meet new/redevelopment.

$$\text{Ratio}_{\text{WFC}-1} = \frac{\text{Volume at overflow of proposed Flow Control BMP}}{\text{Volume at overflow of Flow Control BMP to meet new/redevelopment criteria}}$$

$$If\ \text{Ratio}_{\text{WFC}-1} > 1, then\ set\ \text{Ratio}_{\text{WFC}-1} = 1$$

- Multiply the ratio developed above by the area of the basin contributing to the BMP to obtain the Equivalent New/Redevelopment Area.

$$\text{Area}_{\text{WFC}-1} = \text{Ratio}_{\text{WFC}-1} \times \text{Contributing Basin Area}$$

Procedure WFC-2: Analysis for Size of Bioretention/Permeable Pavement Flow Control BMP

- Run the pre-developed condition for WWHM using the basin area contributing to the BMP.
    - Use forested land cover, except where historic information indicates the area was prairie prior to settlement (then use the pasture land cover)
- Size the Flow Control BMP to meet new/redevelopment criteria for the proposed land use of the basin contributing to the BMP.
- Identify the surface area of the proposed retrofit bioretention or permeable pavement BMP.
- Calculate the ratio of the proposed retrofit BMP surface area to the surface area of the BMP required to meet new/redevelopment.
- Note: Bioretention by itself is not an efficient flow control BMP and needs to be quite large to meet the new/redevelopment criteria.

$$\text{Ratio}_{\text{WFC}-2} = \frac{\text{Surface Area of proposed Bioretention or Permeable Pavement}}{\text{Surface Area of Bioretention or Permeable Pavement to meet new/redevelopment criteria}}$$

$$If\ \text{Ratio}_{\text{WFC}-2} > 1, then\ set\ \text{Ratio}_{\text{WFC}-2} = 1$$

- Multiply the ratio developed above by the area of the basin contributing to the BMP to obtain the Equivalent New/Redevelopment Area.

$$\text{Area}_{\text{WFC}-2} = \text{Ratio}_{\text{WFC}-2} \times \text{Contributing Basin Area}$$

1.2 Procedure for Comparison – Runoff Treatment BMPs

Procedure WRT-1: Analysis of Size of Traditional Flow Rate or Volume Based Runoff Treatment BMP

- Run the pre-developed condition for WWHM using the basin area contributing to the BMP.
    - Use forested land cover, except where historic information indicates the area was prairie prior to settlement (then use the pasture land cover)
- Run the water quality analysis module within WWHM to determine the design flow rate and/or volume for the basin contributing to the Runoff Treatment BMP. Use the on-line or off-line flow rate depending on the configuration of the selected retrofit BMP.
- Using the design flow rate or volume for the Runoff Treatment BMP you are proposing; calculate the ratio between the design flow rate or volume for the retrofit BMP and the design flow rate or volume for the basin contributing to the BMP.

$$\text{Ratio}_{\text{WRT}-1} = \frac{\text{Design flow rate or volume for proposed retrofit treatment BMP}}{\text{Design flow rate or volume to meet new/redevelopment criteria}}$$

$$If\ \text{Ratio}_{\text{WRT}-1} > 1, then\ set\ \text{Ratio}_{\text{WRT}-1} = 1$$

- Multiply the ratio developed above by the area of the basin contributing to the BMP to obtain the Equivalent New/Redevelopment Area.

$$\text{Area}_{\text{WRT}-1} = \text{Ratio}_{\text{WRT}-1} \times \text{Contributing Basin Area}$$

Procedure WRT-2: Analysis of Size of Bioretention Runoff Treatment BMP

- Run the pre-developed condition for WWHM using the basin area contributing to the BMP.
    - Use forested land cover, except where historic information indicates the area was prairie prior to settlement (then use the pasture land cover)
- Run iterations of the bioretention module within WWHM to determine the size of the bioretention BMP that results in a minimum of 91-percent flow through the bioretention

media. Use the Underdrain Used button and do not include native infiltration. In addition, assume vertical walls on the bioretention BMP.

- Using the surface area of the proposed BMP, calculate the ratio between the surface area for the proposed BMP and the surface area for the full basin.

$$\text{Ratio}_{\text{WRT}-2} = \frac{\text{Design flow rate or volume for proposed retrofit treatment BMP}}{\text{Design flow rate or volume to meet new/redevelopment criteria}}$$

$$If\ \text{Ratio}_{\text{WRT}-2} > 1, then\ set\ \text{Ratio}_{\text{WRT}-2} = 1$$

- Multiply the ratio developed above times the area of the full basin to obtain the Equivalent New/Redevelopment Area.

$$\text{Area}_{\text{WRT}-2} = \text{Ratio}_{\text{WRT}-2} \times \text{Contributing Basin Area}$$

1.3 Example Calculations

We use the following sample case in these example calculations:

- Existing Basin Contributing to BMP: 7.0 acres landscaping, flat, 3.0 acres hard surface roads and buildings, Type C soil, 0.3 in/hr native infiltration rate.
- Pre-Developed Scenario: 10.0 acres Type C soil, forested, flat, 0.3 in/hr native infiltration rate.
- Proposed Retrofits :
  - Detention BMP: 1.569 ac-ft at overflow.
  - Traditional treatment BMP: 0.035 cfs design treatment flow rate (on-line).
  - Wet Pond/Vault: 0.115 ac-ft (5,000 cu-ft) design treatment volume.
  - Bioretention BMP 2,500 sq ft surface area, 18-inch media (3 in/hr), 6-inch sand, 18-inch gravel.
  - Permeable Pavement 2-acres (out of 3 acres of hard surface), 0.3 in/hr native infiltration rate. The 3 acres of hard surface is the full contributing area to the proposed permeable pavement.

Procedure WFC-1: Detention/Retention BMP

- Existing Conditions WWHM pond volume at top of outlet (using AutoPond function, and vertical side slopes) = 2.302 ac-ft.
- Proposed Retrofit Pond Volume at top of outlet = 1.569ac-ft.
- Flow Control Ratio of Proposed Pond Volume to Required Pond Volume:

$\text{Ratio}_{\text{WFC}-1}$= 1.569/2.302 = 0.682.

- Equivalent New/Redevelopment Area:

  $\text{Area}_{\text{WFC}-1}$ = 0.682*10 acres = 6.82 acres.

Procedure WFC-2: Permeable Pavement

- Existing Conditions Surface Area required to meet redevelopment criteria (Flow Control duration curve) = < area provided in retrofit project sq ft.
- Proposed Retrofit design Permeable Pavement surface area = 87,120 sq ft (2 acres).
- Treatment Ratio of Proposed Surface Area to required Surface Area is greater than 1.

  Since calculated $\text{Ratio}_{\text{WFC}-2}$> 1, set $\text{Ratio}_{\text{WFC}-2}$= 1

- Equivalent New/Redevelopment Area (only 3 acres contributing to Permeable Pavement).

  $\text{Area}_{\text{WFC}-2}$ = 1*3 acres = 3 acres

Procedure WRT-1: Swale/Manufactured Treatment Device (Uses Water Quality Flow rate)

- Existing Conditions WWHM design flow rate for water quality BMP (on-line) = 0.0800 cfs.
- Proposed Retrofit design flow rate for water quality BMP (on-line flow) = 0.035 cfs.
- Treatment Ratio of Proposed design flow rate to required design flow rate:

  $\text{Ratio}_{\text{WRT}-1}$= 0.035/0.080 = 0.437

- Equivalent New/Redevelopment Area:

  $\text{Area}_{\text{WRT}-1}$= 0.437*10 acres = 4.37 acres

Procedure WRT-1: Wet Pond/Vault

- Existing Conditions Pond Volume required for new/redevelopment criteria (6-month Storm) 0.1614 ac- ft.
- Proposed Retrofit design Wet Pond/Vault Volume = 0.115 ac-ft.
- Treatment Ratio of Proposed design flow rate to required design flow rate

  $\text{Ratio}_{\text{WRT}-1}$= 0.115/0.1614 = 0.712

- Equivalent New /Redevelopment Area

  $\text{Area}_{\text{WRT}-1}$= 0.712*10 acres = 7.12 acres

Procedure WRT-2: Bioretention BMP (underdrain)

- Existing Conditions Surface Area required to meet redevelopment criteria (91-percent treated) = 3,500 sq ft.
- Proposed Retrofit design Bioretention surface area = 2,500 sq ft.
- Treatment Ratio of Proposed design flow rate to required design flow rate:

$$\text{Ratio}_{\text{WRT}-2} = 2{,}500/3{,}500 = 0.714$$

- Equivalent New/Redevelopment Area:

$$\text{Area}_{\text{WRT}-2} = 0.714 * 10 \text{ acres} = 7.14 \text{ acres}$$

2. Eastern Washington

The designer calculates the volume of the Flow Control BMP and the water quality design flow rate or volume needed to meet new/redevelopment criteria. The designer compares these two values to the actual volume of the Flow Control BMP and actual water quality design flow rate for the selected retrofit project. Using these ratios, the designer will calculate the percentage of water quality benefit that the retrofit BMP provides compared to the full new/redevelopment BMP for both Flow Control and Runoff Treatment. You then multiply the resulting ratio by the basin area to obtain the Equivalent New/ Redevelopment Area.

2.1 Procedure for Comparison – Flow Control BMPs

Procedure EFC-1: Analysis for Size of Detention/Retention Flow Control BMP

- Develop the Flow Control BMP sized to meet new development criteria for the full contributing area and the proposed land use. You can use the method that you tell developers to use to determine detention/retention sizing. This will give you the volume of the Flow Control BMP required to meet new/redevelopment.
- Calculate the volume of the proposed retrofit Flow Control BMP at the overflow elevation.
- Calculate the ratio of the proposed retrofit BMP volume to the volume of the BMP required to meet the new development criteria.

$$\text{Ratio}_{\text{EFC}-1} = \frac{\text{Volume at overflow of proposed Flow Control BMP}}{\text{Volume at overflow of Flow Control BMP to meet new/redevelopment criteria}}$$

$$If\ \text{Ratio}_{\text{EFC}-1} > 1, then\ set\ \text{Ratio}_{\text{EFC}-1} = 1$$

- Multiply the ratio developed above times the area of the full basin to obtain the Equivalent New/Redevelopment Area.

$$\text{Area}_{\text{EFC}-1} = \text{Ratio}_{\text{EFC}-1} \times \text{Contributing Basin Area}$$

2.2 Procedure for Comparison – Runoff Treatment BMPs

Procedure ERT-1: Analysis of Size of traditional Flow Rate or volume based Runoff Treatment BMP

- Determine water quality design flowrate and/or volume for full basin (6-month, 24-hr volume or Standard flow rate). Use the method that you tell developers to use to determine water quality treatment flowrate and/or volume. Alternatively, you can use one of the five methods to calculate water quality volume or the three methods to

calculate water quality treatment flow in Chapter 2.2.5 of the SWMMEW. Either use the in-line or off-line flow rate depending on the configuration of the selected retrofit BMP. This treatment BMP should treat 90% of the annual runoff.

- Using the design flow rate or volume for the water quality BMP you are proposing; calculate the ratio between the design flow rate or volume for the retrofit BMP and the design flow rate or volume for the full basin.

$$\text{Ratio}_{\text{ERT}-1} = \frac{\text{Design flow rate or volume for proposed retrofit treatment BMP}}{\text{Design flow rate or volume to meet new/redevelopment criteria}}$$

$$If\ \text{Ratio}_{\text{ERT}-1} > 1, then\ set\ \text{Ratio}_{\text{ERT}-1} = 1$$

- Multiply the ratio developed times the area of the full basin to obtain the Equivalent New/Redevelopment Area.

$$\text{Area}_{\text{ERT}-1} = \text{Ratio}_{\text{ERT}-1} \times \text{Contributing Basin Area}$$

2.3 Example Calculations

We use the following sample case in these example calculations:

- Existing Basin: 7.0 acres Type C soil, landscaping, flat, 3.0 acres hard surface roads and buildings, 0.3 in/hr native infiltration rate.
- Pre-Developed: 10.0 acres Type C soil, forested, flat, 0.3 in/hr native infiltration rate.
- Proposed Retrofits:
    - Detention BMP: 1.569 ac-ft at overflow.
    - Traditional treatment BMP: 0.035 cfs design treatment flow rate (on-line).
    - Wet Pond/Vault: 0.115 ac-ft (5,000 cu-ft) design treatment volume.

Procedure EFC-1: Detention/Retention BMP

- Existing Conditions calculated pond volume at top of outlet = 2.302 ac-ft.
- Proposed Retrofit Pond Volume at top of outlet = 1.569ac-ft.
- Flow Control Ratio of Proposed Pond Volume to Required Pond Volume:

$$\text{Ratio}_{\text{EFC}-1} = 1.569/2.302 = 0.682$$

- Equivalent New/Redevelopment Area:

$$\text{Area}_{\text{EFC}-1} = 0.682*10 \text{ acres} = 6.82 \text{ acres}$$

Procedure ERT-1: Swale/Manufactured Treatment Device (Uses Water Quality Flow Rate)

- Existing Conditions water quality design flow rate for water quality BMP (on-line) = 0.0800 cfs.
- Proposed Retrofit design flow rate for water quality BMP (on-line flow) = 0.035 cfs.
- Treatment Ratio of Proposed design flow rate to required design flow rate:

$$\text{Ratio}_{\text{ERT}-1} = 0.035/0.080 = 0.437$$

- Equivalent New/Redevelopment Area:

$$\text{Area}_{\text{ERT}-1} = 0.437*10 \text{ acres} = 4.37 \text{ acres}$$

Procedure ERT-1: Wet Pond/Vault (Uses Water Quality Volume)

- Existing Conditions Pond Volume required for redevelopment criteria (6-month Storm) 0.1614 ac- ft.
- Proposed Retrofit design Wet Pond/Vault Volume = 0.115 ac-ft.
- Treatment Ratio of Proposed design flow rate to required design flow rate:

$$\text{Ratio}_{\text{ERT}-1} = 0.115/0.1614 = 0.712$$

- Equivalent New /Redevelopment Area:

$$\text{Area}_{\text{ERT}-1} = 0.712*10 \text{ acres} = 7.12 \text{ acres}$$